

CLADOCERA OF PERIYAR LAKE AND ADJACENT SITES, THEKKADY, KERALA¹K.K. SUBHASH BABU^{2,3} AND C.K.G. NAYAR^{2,4}¹Accepted March 2004²Zoological Research Laboratory, Christ College, Thusharam, Azad Road, Irinjalakuda 680 125, Kerala, India.³Email: kallikadavil@yahoo.com⁴Email: ckgnyar@rediffmail.com

The cladoceran fauna of Periyar Lake and adjoining water bodies, situated in the Periyar Tiger Reserve, Kerala, was studied. The present paper deals with the systematic study of 23 species, based on random collections. Females of *Alona clathratula* Sars, *Camptocercus uncinatus* Smirnov, *Biapertura intermedia* Sars and males of *Diaphanosoma sarsi* Richard and *Ceriodaphnia cornuta* Sars were recorded for the first time from India.

Key words: Cladocera, Periyar Lake, systematic study, distribution, India

INTRODUCTION

A review of literature on the freshwater Cladocera of Kerala, India reveals that no attempt has been made to study this fauna. Michael and Hann (1979) reported two species from Thiruvananthapuram. In 1988, Michael and Sharma added eight species from Thiruvananthapuram and nine from Irinjalakuda to the cladoceran fauna of Kerala. Other studies are by Thresiamma *et al.* (1991) on population dynamics, and Subhash Babu and Nayar (1993, 1997) on biology. The present study is a preliminary survey of the microfauna of the aquatic habitats in and around Periyar Lake.

Periyar Lake was formed a century ago due to the construction of the Mullaperiyar dam across River Periyar in 1895. It is situated within the Periyar Tiger Reserve and has an area of 26 sq. km. Periyar Tiger Reserve lies between 9° 15' and 9° 40' N, and 76° 55' and 77° 25' E in the Western Ghats, in Idukki district, Kerala. The height of the Reserve varies from 900 to 2,019 m. The temperature is 15.5 °C during December-January and 31 °C during April-May. The average annual rainfall is 2,500 mm, including both southwest and northeast monsoon.

Although we have information on the terrestrial fauna of Periyar Tiger Reserve, our knowledge of the aquatic fauna is limited. Recently, Zacharias *et al.* (1996) reported the presence of 35 species of fishes in this area, based on collections from lakes and rivers. The crustacean group Cladocera is an important component of freshwater zooplankton.

MATERIAL AND METHODS

Samples from water bodies and canals adjacent to the Lake were collected with the help of a tow net made of bolting silk (70 µm). Specimens were also obtained by washing the

weeds collected from the lake and other water bodies. The samples were immediately preserved in 5% formaline. Dissections were done wherever necessary, using tungsten micro-needle and drawings were made with the help of camera lucida. Measurements were made using calibrated micrometers.

SYSTEMATIC ACCOUNT

Cladocera are generally considered an artificial group comprising representatives of rather different phylogenetic origin. Fryer (1987) classified the "group" Cladocera into 4 Orders, Ctenopoda, Anomopoda, Onychopoda and Haplopoda.

Class: Crustacea

Subclass: Branchiopoda

Order: Ctenopoda

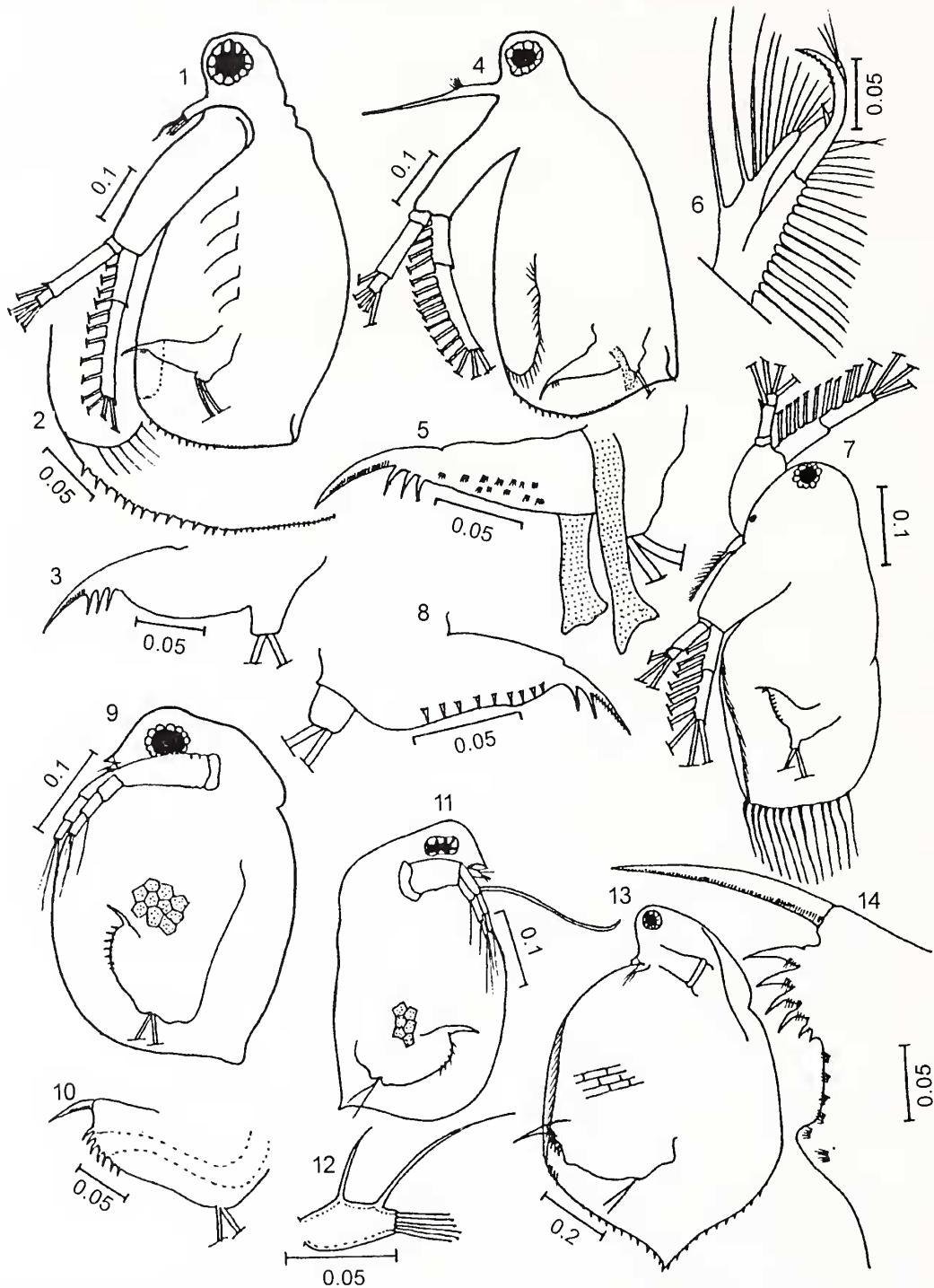
Family Sididae Baird, 1850

1. *Diaphanosoma sarsi* Richard, 1894 (Figs 1-6)

This typical planktonic species was represented by 13 specimens in the samples collected from the littoral regions of the lake. The specimens included 8 parthenogenetic females, 3 ephippial females and 2 males.

Parthenogenetic female: Body somewhat elongated and transparent (Fig. 1); head small with relatively large eyes; without rostrum; valves with varying number of denticles along the posterior ventral corner (Fig. 2); ventral margin inflexed to form a broad flap; antennules small, cigarette-shaped with terminal setae; antennae large but not reaching posterior margin of valves; dorsal ramus 2-segmented and ventral ramus 3-segmented; postabdomen without anal spines; claw with 3 long basal spines (Fig. 3); ephippial female carries 2 ephippia, one on each side.

Male: Smaller than female, characterised by the



Figs 1-6: *Diaphanosoma sarsi* Richard; 1. Female, 2. Shell duplicature, 3. Postabdomen of female, 4. Male, 5. Postabdomen of male, 6. Endopodite of first thoracic leg of male;
 Figs 7-8: *Latonopsis australis* Sars; 7. Female, 8. Postabdomen of female;
 Figs 9-12: *Ceriodaphnia cornuta* Sars; 9. Female, 10. Postabdomen of female, 11. Male, 12. Antennule of male;
 Figs 13-14: *Simocephalus latirostris* Stingelin; 13. Female, 14. Postabdomen of female

presence of long whip-like antennule (Fig. 4), postabdomen with two long sperm ducts (Fig. 5); endopodite of first thoracic leg modified to form a sickle-shaped hook (Fig. 6).

Size: Female - 0.86 x 0.38 mm, Male - 0.67 x 0.32 mm.

Remarks: Females reported by Raghunathan (1989) from Wynaad, Kerala; males reported for the first time from India. Earlier reports of this species from India include those of Gurney (1907) from Bihar, Biswas (1971) from Rajasthan,

Patil (1976) from Meghalaya, Sharma (1978), Venkataraman and Das (2001) from West Bengal, and Michael and Sharma (1988) from Tamil Nadu, West Bengal and New Delhi. *D. sarsi* is a widely distributed species known from Asia, Africa and Australia.

2. *Latonopsis australis* Sars, 1888 (Figs 7-8)

A few females of this species were present in the samples collected among the littoral weeds of the lake and a nearby ditch.

Female: Body elongated; head indistinctly separated from rest of body (Fig. 7); posterior margin of valves with long plumose setae decreasing in length dorsally; antennule segmented with a long flagellum beset with sensory setae; antenna prominent with 3-segmented dorsal ramus and 2-segmented ventral ramus; valve with characteristic shell gland; postabdomen small, with 8-9 marginal spines and claw with 2 long basal spines (Fig. 8).

Size: 1.06 x 0.61 mm.

Remarks: First report from Kerala State. Michael and Sharma (1988) reported the occurrence of this species in Madurai (Tamil Nadu) and Rajasthan. Their specimens differ from the present specimens in having 3 long setae at the posteroventral corner of the valves, and a short postabdomen with only 7 lateral denticles. The specimens from Thekkady, however, show remarkable similarity with *L. australis* described by Korovichinsky (1992) from Queensland, Australia. *Latonopsis occidentalis* Birge, reported by Biswas (1971) from Rajasthan is considered a synonym of *L. australis* by Harding and Petkovski (1963). Venkataraman (1992, 1993, 1995) reported this species from Keoladeo National Park, Rajasthan, and Tamil Nadu. Venkataraman and Das (2001) also reported *L. australis* from West Bengal.

Order: Anomopoda

Family Daphniidae Straus, 1820

3. *Ceriodaphnia cornuta* Sars, 1885 (Figs 9-12)

This species was abundant in the samples collected from the lake and nearby habitats. The population comprised parthenogenetic females, ehippial females and a few males.

Female: Body of parthenogenetic female somewhat rounded in outline (Fig. 9); head small, distinctly separated from rest of body by a conspicuous cervical sinus; ventral margin of head produced into a short rostrum in front of antennules; valves with distinct polygonal markings; margins smooth; posterodorsal corner produced into a blunt process; antennule short, not extending beyond tip of rostrum; horn-like process may or may not be present on anterodorsal margin of head; postabdomen short, with 5-6 sharply pointed anal spines; claw without basal spine (Fig. 10); ehippial female with more rounded body, without head-horn; ehippium with

single oval egg.

Male: Smaller than female (Fig. 11); body quadrangular in outline with straight dorsal margin; antennule longer than that of female, and with two sensory hairs (Fig. 12); first thoracic leg with a prehensile hook and a long flagellum emerging through the ventral margin of valves.

Size: Female: 0.55 x 0.41 mm, Male: 0.38 x 0.22 mm.

Remarks: *Ceriodaphnia cornuta* is widely distributed in the tropical and subtropical regions of the world. In India, it is known from West Bengal (Gurney 1906, Sharma 1978) Bihar (Nasar 1977), Rajasthan (Nayar 1971, Biswas 1971, Venkataraman 1992), Meghalaya (Patil 1976), Karnataka (Patil and Gouder 1988), Kerala (Michael and Sharma 1988), and West Bengal (Venkataraman and Das 2001). Males of *C. cornuta* are being reported for the first time from India.

4. *Simocephalus latirostris* Stingelin, 1906 (Figs 13-14)

This species was represented by 2 parthenogenetic females in a ditch near Kakkara wyal.

Female: Body with its maximum height behind middle (Fig. 13); head small separated from rest of body by a deep cervical sinus; snout projects ventrally forming a rostrum; vertex without spinules; valves ornamented with oblique striations forming a network, dorsal margin arched; ventral margin nearly straight; posterior margin slightly serrated, forming a blunt process; antennule longer than rostrum, sensory seta near its base; antennae reach only half the length of body; postabdomen broad with a prominent preanal angle, its dorsal margin with 6 anal spines increasing in size distally; claw long, without basal spine (Fig. 14).

Size: 1.30 x 0.88 mm.

Remarks: First report from Kerala State. *S. latirostris* is known to be a rare species, never occurring in large numbers. In India, this species was first reported by Biswas (1971) from Rajasthan and subsequently by Michael and Sharma (1988) from Tamil Nadu and Rajasthan.

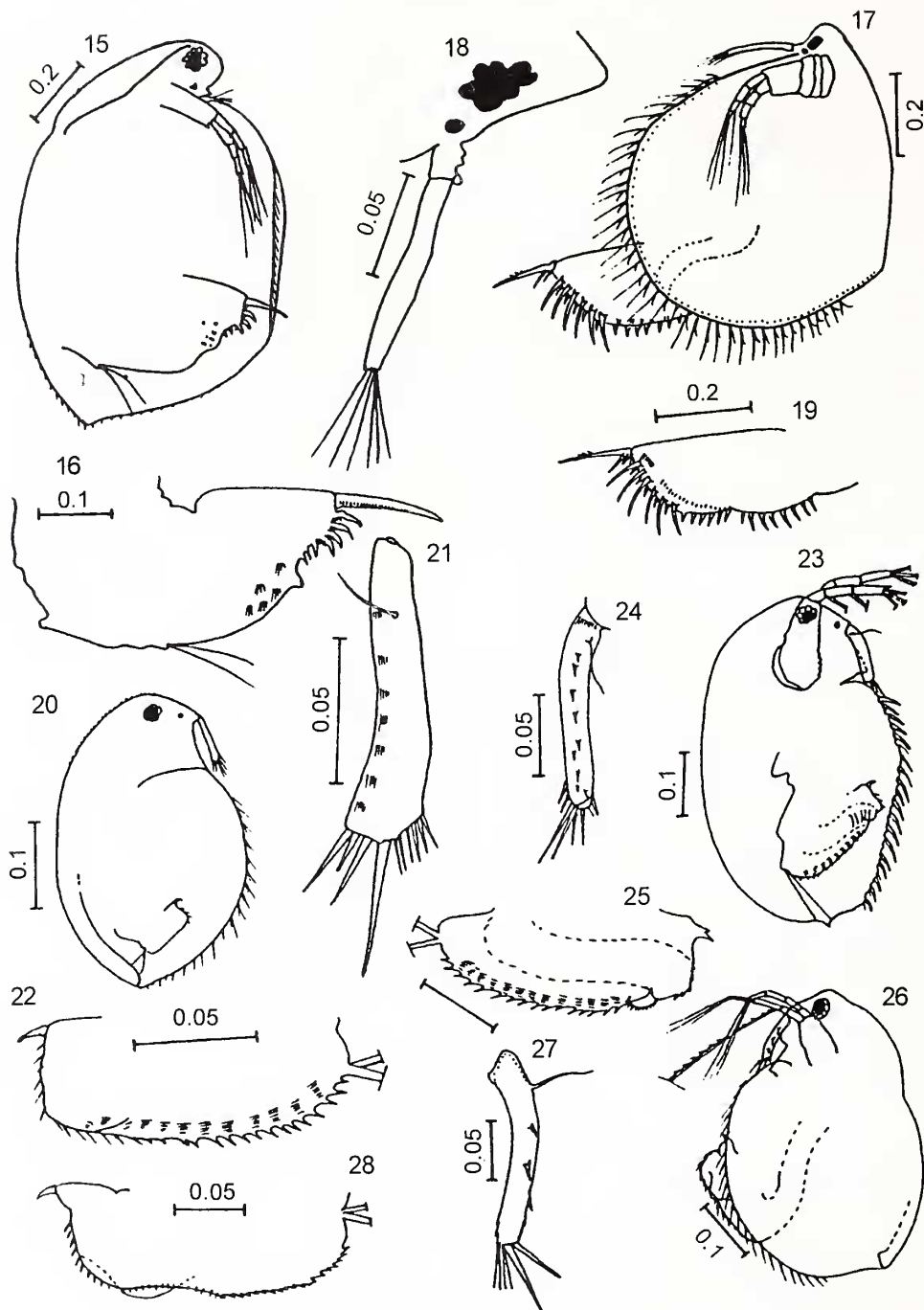
5. *Simocephalus exspinosus* (Koch, 1841) (Figs 15-16)

A large number of parthenogenetic females were present in a ditch adjacent to Periyar Lake.

Female: Body large, somewhat rhomboidal in outline (Fig. 15); head relatively small, with short rostrum; ocellus minute; shell forms a blunt protuberance at its posterior margin; posterior half of shell margin denticulate; valves ornamented with interconnected oblique striations. Antennule extends beyond tip of rostrum; postabdomen broad with acute preanal angle, 12-14 anal spines; claw long, pectinate, without basal spine (Fig. 16).

Size: 1.35 x 0.86 mm.

Remarks: First report from Kerala. *S. exspinosus* is



Figs 15-16: *Simocephalus exspinosus* (Koch); 15. Female, 16. Postabdomen;
 Figs 17-19: *Ilyocryptus spinifer* Herrick; 17. Female, 18. Antennule, 19. Postabdomen of female;
 Figs 20-22: *Macrothrix spinosa* King; 20. Female, 21. Antennule of female, 22. Postabdomen of female;
 Figs 23-25: *Macrothrix triserialis* (Brady); 23. Female, 24. Antennule of female, 25. Postabdomen of female;
 Figs. 26-28: *Macrothrix odiosa* (Gurney); 26. Female, 27. Antennule of female, 28. Postabdomen of female

known to be a cosmopolitan species. In India, it is reported from Meghalaya (Patil 1976), West Bengal (Sharma 1978; Michael and Sharma 1988; Venkataraman and Das 2001) and Karnataka (Patil and Gouder 1988). The specimens from Dharwad described by Patil and Gouder (1988) differ from the present specimens in having a prominent rhomboidal ocellus.

Family Ilyocryptidae Smimov, 1976

6. *Ilyocryptus spinifer* Herrick, 1882 (Figs 17-19)

Five parthenogenetic females were obtained from a temporary water body at Periyar Tiger Reserve.

Female: Body shape characteristic with deeply arched ventral margin (Fig. 17); head small and tapering; ventral

margin of valves with long, branched, plumose setae; antennule, bi-articulated proximal segment short, distal with a few terminal setae (Fig. 18); postabdomen bilobed, with about 25 marginal denticles and long anal spines; claw slender with 2 unequal basal spines (Fig. 19); anal aperture opens in the middle of postabdomen.

Size: 0.67 x 0.53 mm.

Remarks: Michael and Sharma (1988) reported this species at Thiruvananthapuram (Kerala) from the collections of D.G. Frey. It is also known to occur in West Bengal (Gurney 1907, Sharma 1978, Venkataraman and Das 2001), Rajasthan (Biswas 1971, Venkataraman 1992), Meghalaya (Patil 1976) and Karnataka (Patil and Gouder 1988).

Family Macrothricidae Norman & Brady, 1867

7. *Macrothrix spinosa* King, 1852 (Figs 20-22)

A common species, found in several samples from the lake and neighbouring sites.

Female: Body oval, without distinct cervical sinus (Fig. 20); head large with pointed rostrum; eye situated close to margin; ocellus minute; carapace with a blunt protuberance at its posterior margin; anterior dorsal margin minutely serrated; ventral margin with a series of long setae; antennule originates from tip of rostrum, distally expanded; lateral sensory seta near its base; a group of sensory papillae on its apex (Fig. 21); postabdomen short; dorsal margin with strong anal denticles and rows of minute lateral spinules; claw without basal spine (Fig. 22).

Size: 0.36 x 0.25 mm.

Remarks: First report from Kerala. Biswas (1971) and Venkataraman (1992) reported this species from Rajasthan, Patil (1976) from Manipur, Michael and Sharma (1988) from Tamil Nadu and Venkataraman and Das (2001) from W. Bengal.

8. *Macrothrix triseriatis* (Brady, 1886) (Figs 23-25)

A good number of adult females and juveniles were collected from the lake.

Female: Body of adult female nearly oval (Fig. 23); head large, separated from rest of body by a conspicuous cervical depression; shell produced into a sharp angle posteriorly; ventral margin of valves with long bristles; antennule slender, cylindrical, armed with a series of small spinules and a few terminal setae (Fig. 24); postabdomen bilobed with several anteriorly directed denticles along its dorsal margin (Fig. 25); claw short without basal spine.

Size: 0.56 x 0.34 mm.

Remarks: Michael and Sharma (1988) reported this species from Irinjalakuda, Kerala from the collections of C.K.G. Nayar. Also known to occur in Bihar (Gurney 1907) Rajasthan (Biswas 1971, Michael and Sharma 1988), West Bengal

(Michael and Sharma 1988, Venkataraman and Das 2001) and Karnataka (Patil and Gouder 1988).

9. *Macrothrix odiosa* (Gurney, 1907) (Figs 26-28)

A few parthenogenetic females were found in the samples from the lake.

Female: Body oval in outline (Fig. 26); head large, separated from trunk by a distinct cervical sinus; carapace with its posterior protuberance above the middle; valves without any characteristic ornamentation, their margins fringed with setae along whole length; antennule long, slender with a sensory seta near its base, a few short spinules and long terminal setae (Fig. 27); postabdomen large and bilobed (Fig. 28).

Size: 0.76 x 0.53 mm.

Remarks: First report from Kerala. Gurney (1907) reported this species from Bihar, Biswas (1971); Michael and Sharma (1988) from Rajasthan, and Patil and Gouder (1988) from Karnataka.

Family Moinidae Goulden, 1987

10. *Moina micrura* Kurz, 1874 (Figs 29-31)

Several parthenogenetic females and a few ephippial females were present in the lake plankton.

Female: Body small, thick and transparent (Fig. 29); head relatively large, with shallow supraocular depression; a distinct cervical sinus between head and trunk; valves transparent with reticulations and 20-24 spinules on ventral margin; surface of valves devoid of setules or hairs; antennule originates well behind eye; lateral sensory seta situated almost in the middle; antenna reaching only up to middle of valves when extended; postabdomen short, distally conical; with 5 feathered lateral spines and a distal bident tooth; claw long; ephippium saddle-shaped, hard, darkly pigmented, containing one egg.

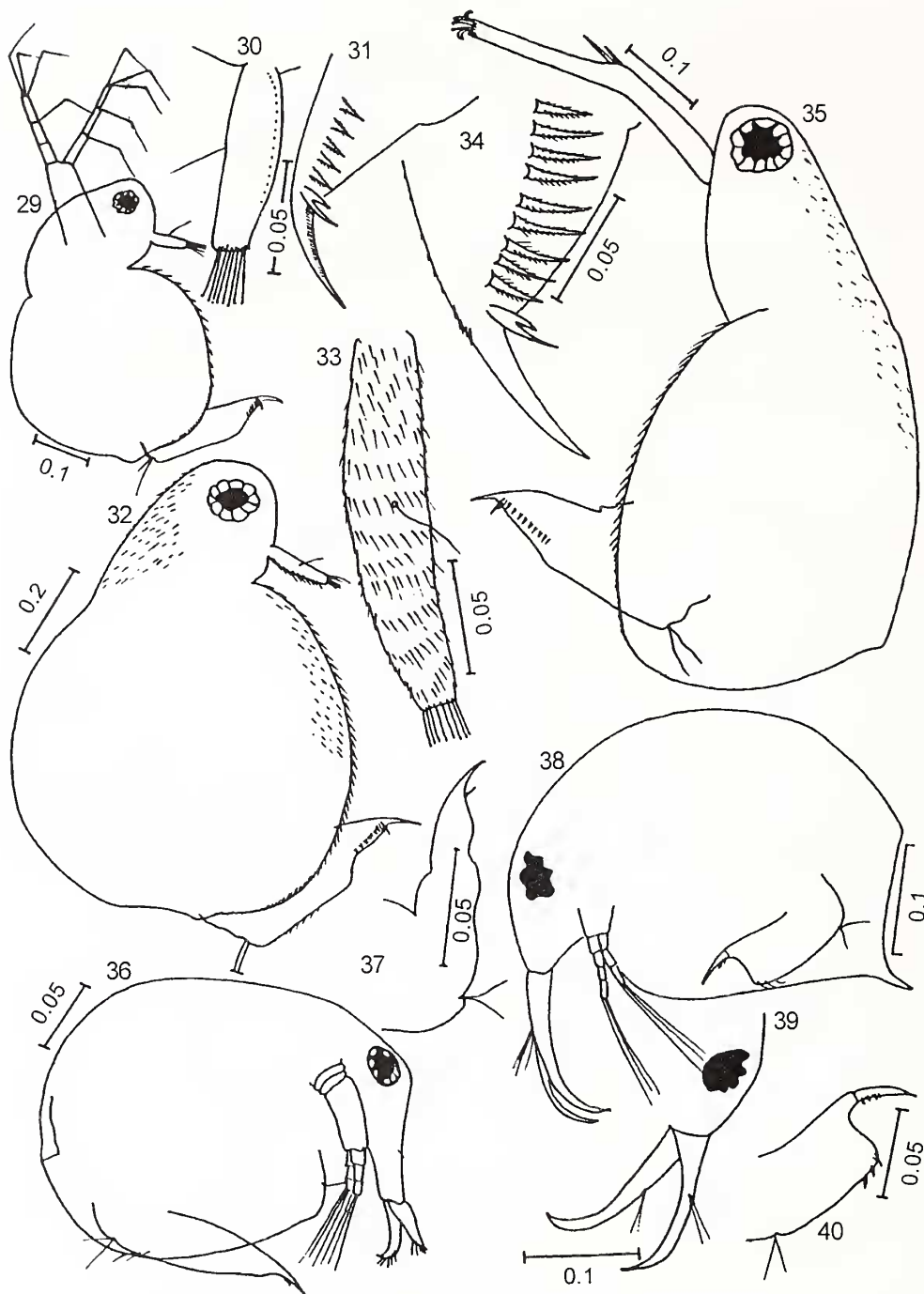
Size: 0.75 x 0.44 mm.

Remarks: *M. micrura* is widely distributed in India, known from West Bengal (Sewell 1935, Sharma 1978, Michael and Sharma 1988, Venkataraman and Das 2001), Tamil Nadu (Brehm 1936, Michael and Sharma 1988), Karnataka (Patil and Gouder, 1988), Rajasthan (Biswas 1971), Kerala (Michael and Sharma 1988, Raghunathan 1989).

11. *Moina macrocopa* (Straus, 1820) (Figs 32-35)

A sample obtained from a temporary water body at Periyar Tiger Reserve contained several parthenogenetic females, 3 ephippial females and 5 males of this species

Female: Large-sized forms (Fig. 32); head broadly rounded without supraocular depression; no ocellus; head and body covered with fine setules, setulation more dense towards dorsal half; valves granulated with faint reticulations



Figs 29-31: *Moina micrura* Kurz; 29. Female, 30. Antennule of female, 31. Anterior portion of female postabdomen;
 Figs 32-35: *Moina macrocopa* (Straus); 32. Female, 33. Antennule of female, 34. Anterior portion of female postabdomen, 35. Male;
 Figs 36-37: *Bosminopsis deitersi* Richard; 36. Female, 37. Postabdomen of female;
 Figs 38-40: *Bosmina longirostris* (O.F. Muller); 38. Female, 39. Head with antennule, 40. Postabdomen of female.

formed by interconnected longitudinal lines; ventral margin armed with 80-90 small setae, followed by ungrouped setules; antennules large, covered by hairs and setules; lateral sensory seta near the middle (Fig. 33). Antenna stout and hairy; first thoracic leg of female distinct in having teeth on the ventral margin of the penultimate segment of anterior seta;

postabdomen large with 9 long feathered lateral spines and a distal bident tooth, claw pectinate (Fig. 34). Ehippial females smaller than parthenogenetic females; setules absent on head and valves; ehippium saddle-shaped, ornamented with polygonal markings, contains 2 eggs.

Male: Smaller than female (Fig. 35); head and trunk

densely covered by hairs; antennules very long, bent at middle; 2 lateral setae of unequal length; 5 terminal hooks; first thoracic leg of male distinct, with large recurved hooks on penultimate segment; postabdomen similar to that of female.

Size: Female: 1.06 x 0.65 mm, Male: 0.65 x 0.36 mm.

Remarks: First report from Kerala. Goulden (1968) considers *Monia easu* Brehm, 1936 from Nilgiri Hills Tamil Nadu and *Moina ganapati* Brehm, 1963 from River Yamuna, Delhi as synonyms of *M. macrocopa*.

Family Bosminidae Sars, 1865

12. *Bosminopsis deitersi* Richard, 1875 (Figs 36-37)

A few parthenogenetic females in the lake plankton represented this species.

Female: Minute form with oval body, maximum height behind middle (Fig. 36); head with long rostrum forming proboscis-like structure; valves ornamented with reticulations; posterior corner rounded. Antennules united at their bases, diverge distally carrying a few terminal setae; postabdomen tapering distally; claw with prominent basal spine (Fig. 37).

Size: 0.28 x 0.20 mm.

Remarks: Michael and Sharma (1988) reported this species at Irinjalakuda, Kerala from the collections of C.K.G. Nayar. They differ from Thekkady specimens in having a small mucronate process and a few spinules on the posteroventral corner of the valves. Patil and Gouder (1988) had one form with 2 spines and another with a single spine on the posteroventral corner of the valves. Idris (1983) observed a long and sharply pointed marginal spine on the posteroventral corner in his collections from Malaysia. These observations indicate that this is a variable character in *B. deitersi*.

13. *Bosmina longirostris* (O.F. Muller, 1776) (Figs 38-40)

A few specimens of this species were obtained from a small ditch in the Periyar Tiger Reserve.

Female: Body transparent with an arched dorsal margin; posterior margin straight; posteroventral corner produced into a conspicuous backwardly directed spine (Fig. 38); head large, smoothly arched in front of eye; antennules long, parallel to each other, terminally bent backwards; olfactory setae nearer to the base than to tip of the antennule (Fig. 39); antenna small with 3-segmented dorsal ramus and 4-segmented ventral ramus; postabdomen quadrate with 3 anal spines; claw with a proximal pecten of 4 spinules (Fig. 40).

Size: 0.41 x 0.29 mm.

Remarks: First report from Kerala. Brehm (1936) reported this species from Dal Lake, Kashmir; Yousuf and Quadri (1977) from Malpur Sar, Kashmir; Sharma (1978),

Venkataraman and Das (2001) from West Bengal; Patil (1976) from Meghalaya, and Michael and Sharma (1988) from Madhya Pradesh, West Bengal and Meghalaya.

Family Chydoridae Stebbing, 1902

Sub-Family Chydorinae Stebbing, 1902

14. *Picripleuroxus similis* (Vavra, 1900)

(=*Pleuroxus similis* Vavra, 1900). (Figs 41-43)

A few female specimens were obtained from a ditch near Kokkara wayal, Thekkady.

Female: Carapace with evenly arched dorsal margin, straight posterior margin and without any ornamentation; ventral margin of valves with feathered setae; posteroventral corner produced into a blunt spine (Fig. 41); head with long pointed rostrum curved backwards; labrum with convex anterior margin and rounded ventral margin (Fig. 42); antennules short, never reaching tip of rostrum; postabdomen slightly tapering distally, 9-10 anal spines; claw with 2 unequal basal spines, proximal shorter (Fig. 43).

Size: 0.44 x 0.30 mm.

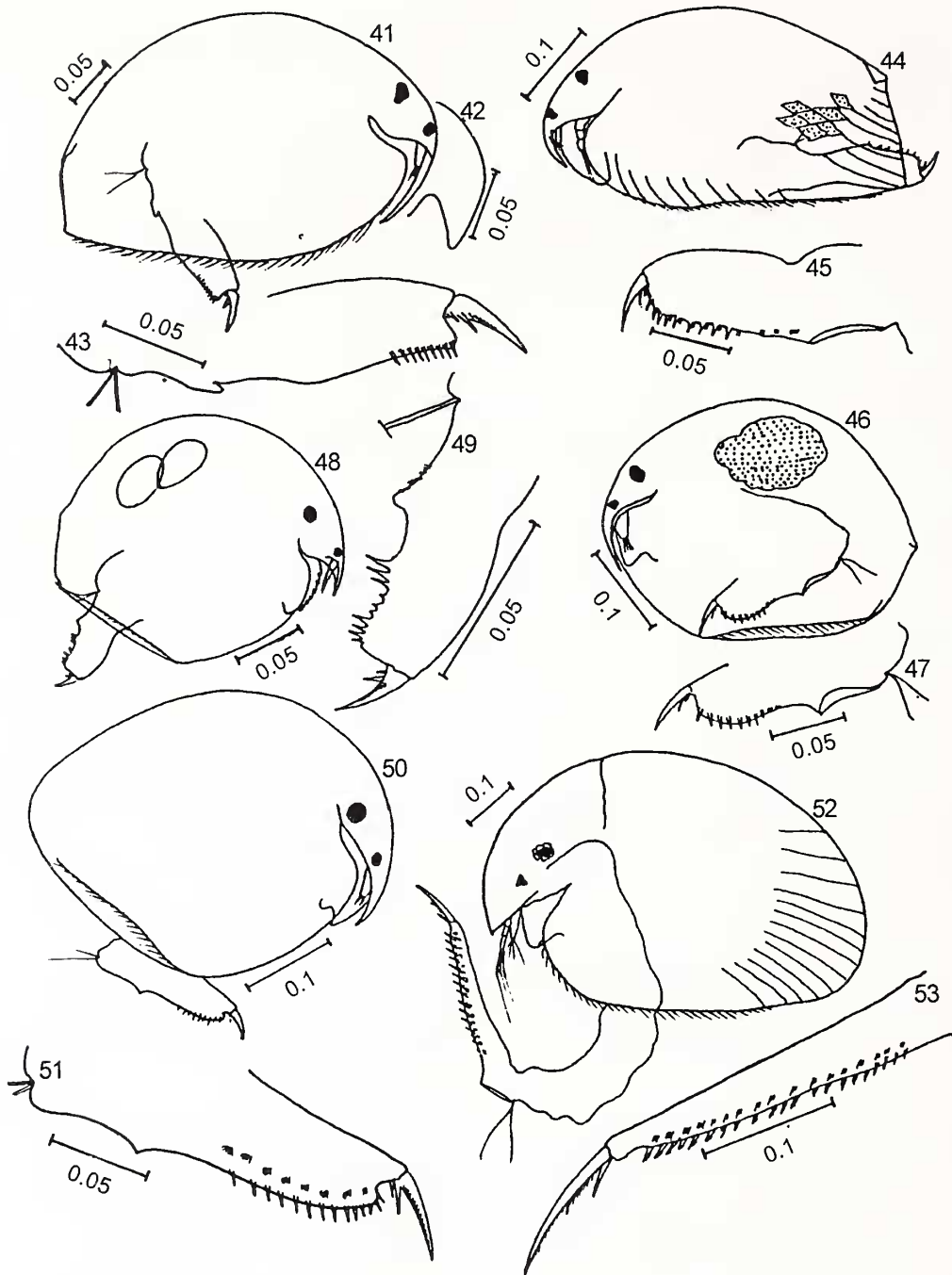
Remarks: Frey (1993) suggested the generic name '*Picripleuroxus*' for much elongated animals with elongated postabdomen. The present species can be distinguished from the closely related *Pleuroxus trigonellus* (O.F. Muller) by the presence of non-reticulated valves. The number of anal spines is found to be a variable character in Thekkady specimens. Yousuf and Quadri (1977), and Quadri and Yousuf (1978) reported this species from Kashmir. Other Indian reports include Sharma (1978) and Venkataraman and Das (2001) from West Bengal, Michael and Sharma (1988) from Shillong, Venkataraman (1992) from Bharatpur, Rajasthan. The present report is the first from Kerala.

15. *Alonella clathratula* Sars, 1896 (Figs 44-45)

Several parthenogenetic females were present along with *Picripleuroxus similis* in the samples collected from a ditch near Kokkara wayal, Thekkady.

Female: Body somewhat elongated and oval, with slightly arched dorsal margin and straight posterior margin, which is more than half of the maximum body height (Fig. 44); valves ornamented with polygons with longitudinal striations and stipples; ventral margins of valves with plumose setae along whole length; head relatively small with long pointed curved rostrum; antennule small, reaching middle of rostrum; labrum rounded anteriorly with a shallow notch at its apex; postabdomen with distinct preanal angle; 9 anal spines and a few setules; claw of moderate size with 2 basal spines of unequal size (Fig. 45).

Size: 0.32 x 0.22 mm.



Figs 41-43: *Picripleuroxus similis* (Vavra); 41. Female, 42. Plate of labrum, 43. Postabdomen of female;
 Figs 44-45: *Alona clathratula* Sars; 44. Female, 45. Postabdomen of female;
 Figs 46-47: *Chydorus eurynotus* Sars; 46. Female, 47. Postabdomen of female;
 Figs 48-49: *Ephemeroporus barroisi* (Richard); 48. Female, 49. Postabdomen of female;
 Figs 50-51: *Chydorus ventricosus* Daday; 50. Female, 51. Postabdomen of female;
 Figs 52-53: *Camptocercus uncinatus* Smirnov; 52. Female, 53. Anterior portion of Postabdomen

Remarks: Although the present species is similar to *A. excisa*, its body and postabdomen are more elongated and more similar to *A. clathratula*. In *A. clathratula* the valves are ornamented with granulated polygons and longitudinal

striations while in *A. excisa* the polygons are not granulated. Moreover, in *A. clathratula* the labrum has a slight depression at its anteroventral end. *A. clathratula* is reported for the first time from India.

16. *Chydorus euryuotus* Sars, 1901 (Figs 46-47)

Present in the plankton samples collected from the lake.

Female: Body somewhat spherical, with distinct posterodorsal corner (Fig. 46); valves without markings; dorsal margin more arched than ventral margin; posteroventral margin characteristic with a double contour margin and a row of plumose setae on inner margin; head shield broadly rounded posteriorly and pointed anteriorly; rostrum long with pointed apex; antennule small, reaching half way to tip of rostrum; postabdomen with distinct pre-anal corners (Fig. 47); dorsal margin of postabdomen armed with 9 anal spines and claw with two unequal basal spines.

Size: 0.36 x 0.27 mm.

Remarks: First report from Kerala. Earlier reports in India are those of Nayar (1971) and Venkataraman (1990) from Rajasthan, and Battish (1981) from Punjab.

17. *Ephemeroporus barroisi* (Richard, 1894) (Figs 48-49)

Large numbers of parthenogenetic females were collected from a lake.

Female: Body with arched dorsal margin, with maximum height in the middle (Fig. 48); posterior margin straight and short with posterodorsal angle and short spine at posteroventral corner; ventral margin forms a broad angle in the middle and is setulated posteriorly; valves ornamented with polygonal cell markings; rostrum short, pointed and directed downwards; ocellus much smaller than eye, situated at half the length of rostrum; antennule reaches about half the length of the rostrum; labrum characteristic with serrated anterior margin having 5-6 teeth and a bluntly pointed ventral margin; postabdomen relatively short with prominent preanal corner and 9-10 anal spines of unequal length (Fig. 49); claw with two basal spines, of which proximal one much shorter than the distal.

Size: 0.27 x 0.18 mm.

Remarks: First report from Kerala. The present specimen agrees with the description given by Smirnov (1996). Michael and Sharma (1988) recorded this species from Thiruvananthapuram from the collections of D.G. Frey. It is also known from Gujarat (Petkovski 1966) and West Bengal (Sharma 1978; Venkataraman and Das 2001).

18. *Chydorus ventricosus* Daday, 1898 (Figs 50-51)

Female specimens collected from littoral weedy margin of lake.

Female: Body somewhat oval, with rounded posterodorsal and posteroventral corners; ventral margin strongly bulging outwards at the middle; posteroventral margin with double line (Fig. 50); valves ornamented with faint wavy hexagonal markings; rostrum long, pointed and

slightly bent backwards; antennules reach about half the length of rostrum; postabdomen long, tapering with distinct pre-anal, post-anal corners and with 12-14 anal spines (Fig. 51); claw setulated with 2 basal spines of unequal length.

Size: 0.5 x 0.31 mm.

Remarks: This species was reported from Kerala by Michael and Sharma (1988) from Thiruvananthapuram and Irinjalakuda, Ragunathan (1989) from Wynaad. It is also recorded in Nilgiri Hills, Tamil Nadu (Brehm 1936) Gujarat (Petkovski 1966), Rajasthan (Biswas 1971, Michael and Sharma 1988), and West Bengal (Venkataraman and Das 2001).

Sub-Family Aloninae Frey, 1967

19. *Camptocercus uncinatus* Smirnov, 1991 (Figs 52-53)

Two mature females were obtained from Kokkara wayal ditch, Thekkady.

Female: Body nearly oval, with arched dorsal and almost straight ventral margin, with series of setae (Fig. 52); maximum height slightly anterior to the middle of the body; posteroventral corner rounded and smooth, without denticles; valves ornamented with several longitudinal parallel lines; rostrum broad and slightly pointed; ocellus smaller than eye, situated nearer to the eye than to the tip of rostrum; antennule almost reaching the tip of rostrum; postabdomen very long, narrow, with about 20 anal denticles; claw with large basal spine (Fig. 53).

Size: 0.68 x 0.47 mm.

Remarks: The specimens agree with the description by Smirnov (1974). This is the first report from India.

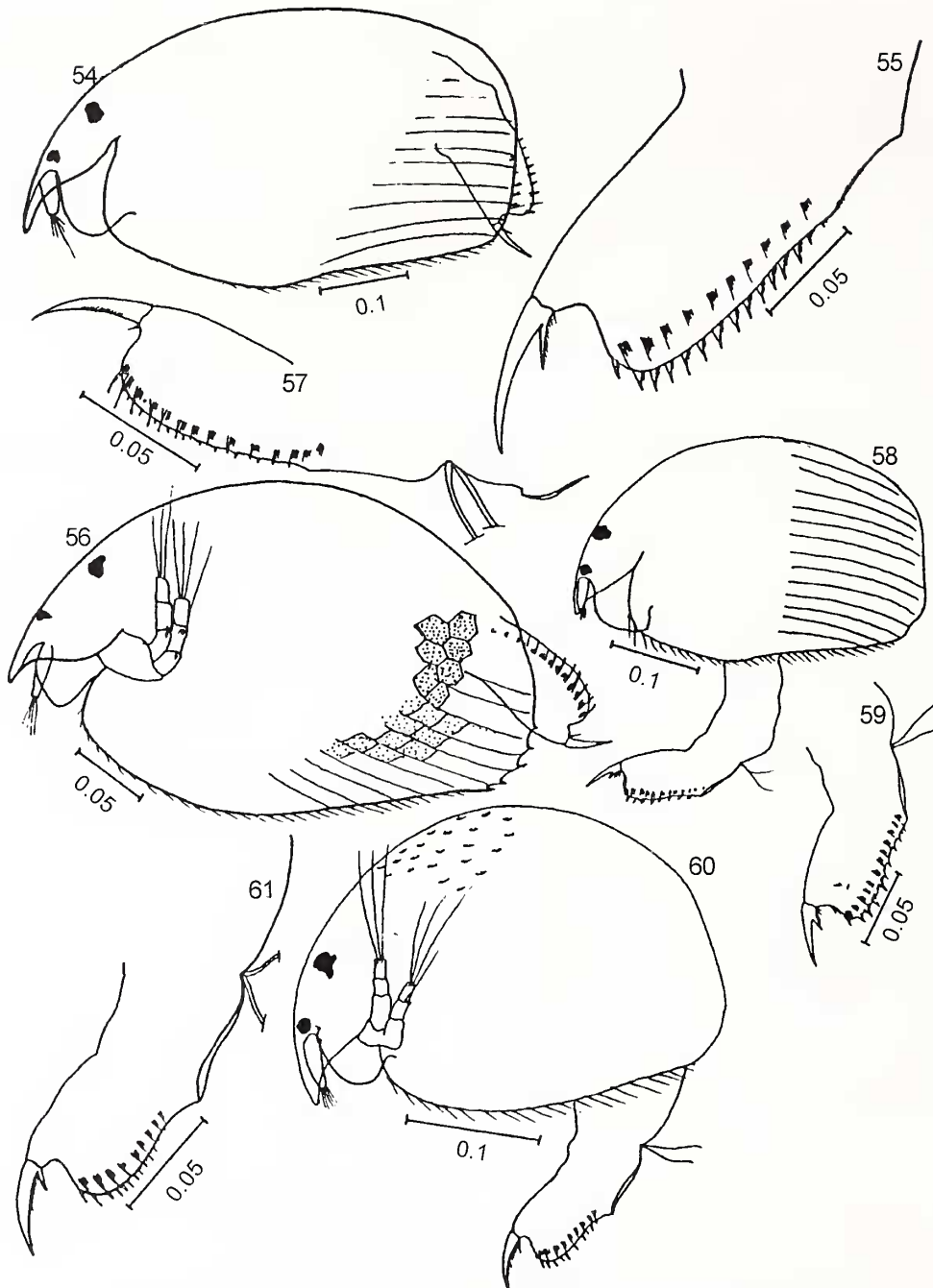
20. *Biapertura affinis* (Leydig, 1860) (Figs 54-55)

A few specimens collected from among the weeds of Kokkara wayal ditch, Thekkady.

Female: Body oblong with arched dorsal margin, nearly straight setulated ventral margin and rounded posterodorsal and posteroventral corners (Fig. 54); valves with longitudinal striations that are more distinct towards posterior and ventral margins; head shield with pointed posterior margin and two median head pores with narrow connection between them, in addition to two lateral pores situated one on either side of the anterior pore; rostrum blunt and antennules not reaching the apex of rostrum; labrum evenly rounded anteriorly, somewhat pointed ventrally; postabdomen of almost uniform width, with about 15 anal denticles and about 10 groups of lateral setae (Fig. 55); claw long with single basal spine.

Size: 0.62 x 0.34 mm.

Remarks: First report from Kerala. In India, this species is known from Kashmir (Brehm 1936), Gujarat (Petkovski 1966), West Bengal (Sharma 1978, Michael and Sharma 1988) Meghalaya (Michael and Sharma 1988) and Punjab (Battish 1992).



Figs 54-55: *Biapertura affinis* (Leydig): 54. Female, 55. Postabdomen of female;
 Figs 56-57: *Biapertura karuva* (King): 56. Female, 57. Postabdomen of female;
 Figs 58-59: *Biapertura intermedia* Sars: 58. Female, 59. Postabdomen (female);
 Figs 60-61: *Biapertura verrucosa* (Sars): 60. Female, 61. Postabdomen (female)

21. *Biapertura karuva* (King, 1852) (Figs 56-57)

Female specimens were collected from the lake near the boathouse.

Female: Body of female with evenly arched dorsal margin, its maximum height being a little behind the middle of the body (Fig. 56); valves with rounded posteroventral corners, with about 5 denticles which is characteristic of the

species; valves ornamented with oblique parallel striations and polygon markings; rostrum blunt, antennules almost reaching its apex; postabdomen broadly rounded, distal dorsal margin armed with 8-10 anal denticles and 11-13 groups of lateral setae that may extend beyond its dorsal margin (Fig. 57); claw with very short basal spine.

Size: 0.36 x 0.23 mm.

Remarks: First report from Kerala. The number of denticles on the posteroventral corner of the carapace varies from 1-5. In India, this species was reported from West Bengal (Sharma 1978, Venkataraman and Das 2001), Meghalaya (Patil 1976), Tamil Nadu (Michael and Sharma 1988), Rajasthan (Venkataraman 1990) and Punjab (Battish 1992).

22. *Biapertura intermedia* Sars 1862 (Figs 58-59)

Seven parthenogenetic females were obtained from the weeds collected from the lake.

Female: Body sub-quadrate with rounded posterodorsal and posteroventral corners; dorsal margin of carapace arched, ventral margin straight with series of setae (Fig. 58); valves ornamented with parallel lines; rostrum blunt, antennule not reaching apex of rostrum. Postabdomen with rounded distal corner, armed with 8 anal denticles decreasing in size proximally and 10-11 groups of lateral setae; with single basal spine (Fig. 59).

Size: 0.38 x 0.25 mm.

Remarks: The present species is reported for the first time from India.

23. *Biapertura verrucosa* (Sars, 1901) (Figs 60-61)

This species is common among the littoral weeds of the lake.

Female: Body with arched dorsal margin, setulated ventral margin, maximum height at the middle (Fig. 60); valves with rounded posteroventral and evenly rounded posterodorsal margins; valves ornamented with character-

istic tubercles or verrucae, more distinct interiorly; rostrum blunt, antennule hardly reaching apex of rostrum; postabdomen with distinct pre-anal and post-anal corners, dorsal margin armed with 9-11 anal denticles and 9-10 groups of lateral setae; claw with single basal spine (Fig. 61).

Size: 0.32 x 0.23 mm.

Remarks: The species was reported from Gujarat (Petkovski 1966), Rajasthan (Nayar 1971, Venkataraman 1990, Michael and Sharma 1988) and West Bengal (Venkataraman and Das 2001).

CONCLUSION

The occurrence of 23 species of Cladocera, based on a few random collections, indicates the richness of Cladoceran fauna in this high altitude lake. Of the 23 species, 15 species are recorded for the first time from Kerala State. The present study indicates that an extensive survey of different freshwater habitats will definitely add more species to the freshwater cladoceran fauna of Kerala.

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